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ABSTRACT

DiPietro, Larson, and Porges (1987) found behavioral and physiological differences between breast-fed and bottle-fed newborns. It was suggested that breast-feeding is associated with more optimal physiological organization and with increased irritable reactivity early in the neonatal period. The present study investigated whether breast-fed neonates' more optimal physiological organization leads to more optimal development later in infancy. A total of 29 breast-fed and 15 bottle-fed infants who had participated in a newborn study were seen again at 15 months of age. During the assessment of newborns, 10 minutes of heart pattern and respiration data were collected and the Neonatal Behavioral Assessment Scale was administered. At 15 months, the Bayley Scales of Infant Development and the Infant Characteristics Questionnaire were administered. Findings revealed that breast-fed infants scored significantly higher than bottle-fed infants on the Bayley Mental Development Index (MDI) at 15 months of age and tended to be rated as more fussy-difficult-demanding by their parents at 15 months. The decision to breast-feed was related to outcome at both the newborn period and at 15 months of age. Level of parent education and duration of breast-feeding were not related to outcome. It is concluded that, insofar as the predictive influence of feeding style is largely accounted for by neonatal vagal tone, that variable may mediate the observed developmental differences. (RH)

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OUTCOME DIFFERENCES BETWEEN BREAST-FED AND BOTTLE-FED INFANTS

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ABSTRACT

DiPietro, Larson, and Porges (1987) found behavioral and physiological differences between breast-fed and bottle-fed newborns. It was suggested that breast-feeding is associated with more optimal physiological organization and with increased irritable reactivity early in the neonatal period. The present study followed a subset of these newborns to determine whether the more optimal physiological organization demonstrated by higher levels of vagal tone observed in breast-fed infants early in the neonatal period led to more optimal development later in infancy. Breast-fed infants scored significantly higher on the Bayley MDI at 15 months and tended to be rated as more fussy-difficult by their parents at 15 months. Neither level of parent education or duration of breast-feeding was related to outcome. Level of parent education was related to duration of breast-feeding. Regression analyses demonstrated that the predictive influence of feeding election was not independent of neonatal vagal tone.

PURPOSE

DiPietro, Larson, and Porges (1987) found behavioral and physiological differences between breast-fed and bottle-fed newborns. Breast-fed infants had significantly longer heart periods, elevated heart period variability, and higher vagal tone than bottle-fed infants. During administration of the Neonatal Behavioral Assessment Scale (NBAS) (Brazelton, 1984), breast-fed infants were significantly more irritable, more difficult to console, and more often unable to complete the orientation items. These results could not be attributed to perinatal status or maternal variables, such as birth weight, labor and delivery medication, and socioeconomic status. It was suggested that breast-feeding is associated with more optimal physiological organization early in the neonatal period and with increased irritable reactivity.

These differences between breast-fed and bottle-fed infants were observed between 17 and 56 hours post partum. The present study followed a subset of these newborns to determine whether the more optimal physiological organization demonstrated by higher levels of vagal tone observed in breast-fed infants early in the neonatal period led to more optimal development later in infancy.

METHOD

Twenty-nine breast-fed and 15 bottle-fed infants who had participated in a newborn study were seen again at 15 months of age. During the newborn assessment, 10 minutes of heart pattern and respiration data were collected while the infant was in quiet or active sleep, followed by the administration of the NBAS. Heart period, heart period variability, and an index of neural control of the heart by the vagus (i.e., vagal tone) were analyzed. At 15 months, the Bayley Scales of Infant

Development and the Infant Characteristics Questionnaire (ICQ) (Bates, Freeland, & Lounsbury, 1979) were administered.

RESULTS

Breast-fed infants showed more optimal cardiac physiology as newborns, scored significantly higher on the Bayley MDI at 15 months, and tended to be rated by their parents as more fussy-difficult-demanding than bottle-fed infants (see Table 1). The decision to breast feed was also related to level of parent education.

Since duration of breast-feeding was correlated with mother's education (r=.43), and may also be related to outcome, infants were divided into 3 groups: 1) bottle-fed, 2) breast-fed $\leq$ 4 months, and 3) breast-fed > 4 months. Analyses of variance with planned comparisons were performed to examine differences between these 3 groups (see Table 2). Comparison between the two breast-fed groups demonstrated that duration of breast-feeding was not related to newborn physiology, 15-month Bayley MDI scores, or parent rated fussy-difficultness. Duration of feeding was related to parent education, with more educated parents breast-feeding longer. There was no difference in parent education between those who elected to bottle-feed and those who breast-fed $\leq$ 4 months. Inspection of Table 2 indicates that the bottle-fed and short duration breast-fed groups were significantly different in newborn physiology and 15-month Bayley MDI, although they did not differ on parent education.

Both neonatal vagal tone and feeding election were related to 15-month Bayley MDI. Regression analyses demonstrated that the predictive influence on feeding election was not independent of neonatal vagal tone (see Table 3).

DISCUSSION

DiPietro et al. (1987) found breast-feeding to be associated with more optimal physiological organization and increased irritable reactivity early in the neonatal period. The present study found that breast-fed infants scored higher on the Bayley MDI at 15 months and tended to be rated as more fussy-difficult-demanding by their parents at 15 months. The election to breast-feed, not level of parent education or duration of breast-feeding, related to outcome at both the newborn period and at 15 months.

Since the predictive influence of feeding style is largely accounted for by neonatal vagal tone, we speculate that neonatal vagal tone may mediate the observed developmental differences. Future investigations must address the mechanisms which promote the higher neonatal vagal tone observed within 48 hours after birth in infants of mothers who elect to breast feed. Although these findings suggest that early breast-feeding is associated with more optimal outcome, there is much variability in outcome indicating other factors must also be investigated.

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TABLE 1

Differences Between Breast-fed and Bottle-fed Infants

Measure	Breast-fed (N=29) M	SD	Bottle-fed (N=15) M	SD	t
Newborn Physiology					
HP	529.52	35.83	495.00	47.86	2.70***
HPV	6.76	0.68	6.18	0.99	2.28**
Vagal tone	4.28	0.95	3.50	1.09	2.48**
Bayley at 15 Months					
MDI	122.41	11.52	114.47	8.80	2.34**
PDI	115.00	3.93	115.20	9.37	-0.10
ICQ					
Fussy-difficult	29.79	6.65	25.93	6.35	1.85*
Unadaptable	15.90	4.48	16.27	4.40	-0.26
Persistent	13.00	3.42	12.07	3.67	0.84
Unsociable	6.97	2.08	7.73	2.50	-1.09
Parent's Education					
Mother	15.24	2.15	13.36	1.86	2.81***
Father	15.79	2.54	13.79	1.80	2.64***

* = $p < .08$; ** = $p < .05$; *** = $p < .01$

TABLE 2

Analysis of Variance by Duration of Feeding

Measures	Means: Bottle-fed (N=15)	Means: Breast-fed ≤ 4 months (N=15)	Means: Breast-fed > 4 months (N=14)	F
Newborn Physiology				
HP	495.00	530.57	528.40	3.56**
HPV	6.18	6.74	6.78	2.56*
Vagal tone	3.50	4.34	4.22	3.05**
Bayley at 15 Months				
MDI	114.47	122.27	122.57	2.67*
PDI	115.20	116.33	113.57	0.71
ICQ				
Fussy-difficult	25.93	28.87	30.79	2.01*
Parental Education				
Mother	13.36	14.33	16.21	7.94***
Father	13.79	14.87	16.79	6.59***

* = $p < .10$; ** = $p < .05$; *** = $p < .01$

TABLE 3

Multiple Regressions Predicting Bayley MDI From Feeding Method, Neonatal Vagal Tone, and Maternal Education

Covariates	Multiple R	R^2	R^2 increase	F	df
Dependent variable - Bayley MDI					
Feeding	.366	.134	.134	6.35***	(1,41)
Neonatal vagal tone	.416	.172	.039	1.88	(2,40)
Dependent variable - Bayley MDI					
Neonatal vagal tone	.314	.099	.099	4.48**	(1,41)
Feeding	.416	.173	.075	3.60*	(2,40)
Dependent variable - Bayley MDI					
Maternal education	.096	.009	.009	0.37	(1,40)
Feeding	.206	.043	.033	1.36	(2,39)
Neonatal vagal tone	.307	.094	.051	2.17	(3,38)

* = $p < .08$; ** = $p < .05$; *** = $p < .01$